



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

**CHEMISTRY**

**5070/11**

Paper 1 Multiple Choice

**October/November 2012**

**1 hour**

Additional Materials: Multiple Choice Answer Sheet  
Soft clean eraser  
Soft pencil (type B or HB recommended)



**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 16.

This document consists of **13** printed pages and **3** blank pages.



- 1 It is suspected that a lollipop contains traces of a poisonous green dye (boiling point  $73^{\circ}\text{C}$ ) as well as two harmless orange and red dyes (boiling points  $69^{\circ}\text{C}$  and  $73^{\circ}\text{C}$  respectively).

What is the best method by which the green dye may be detected?

- A filtration
  - B fractional distillation
  - C paper chromatography
  - D recrystallisation
- 2 Element X does not conduct electricity and has a low melting point.

Which could be element X?

- A carbon (graphite)
- B iodine
- C mercury
- D sodium

- 3 Substance Q is a soluble salt.

An aqueous solution of Q is tested as shown.

test	observation
warm Q with aqueous sodium hydroxide	alkaline gas given off, no precipitate formed
to Q add dilute nitric acid and barium nitrate solution	white precipitate forms

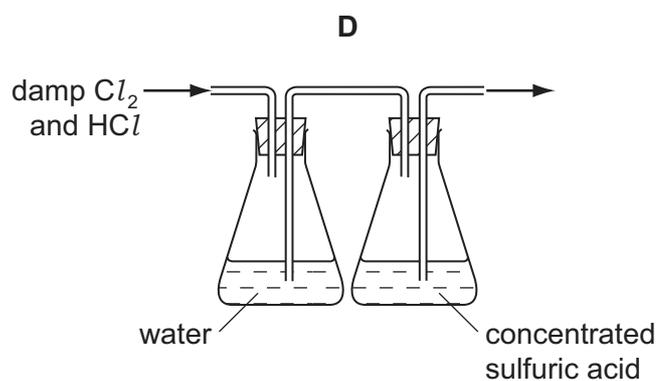
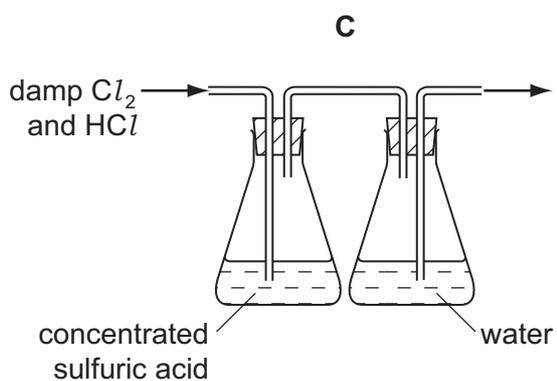
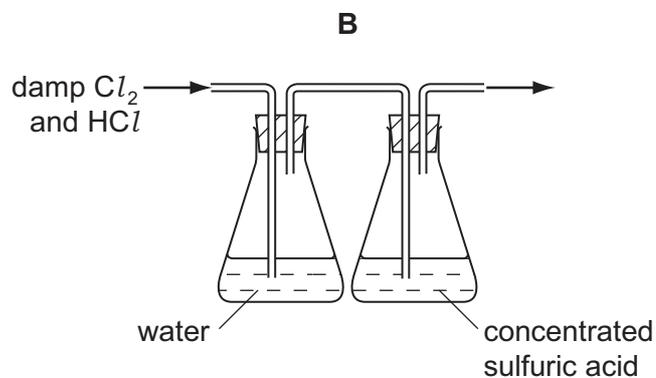
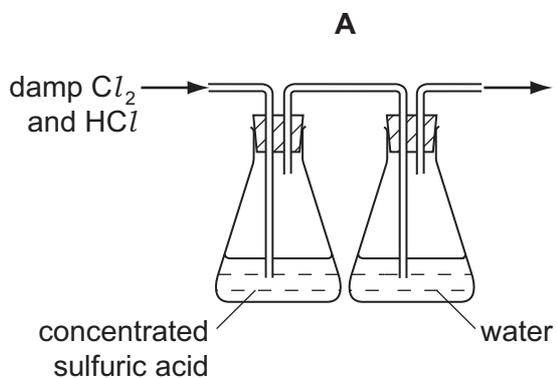
What is Q?

- A ammonium chloride
  - B ammonium sulfate
  - C zinc chloride
  - D zinc sulfate
- 4 Which statement explains why the gases propane,  $\text{C}_3\text{H}_8$ , and carbon dioxide,  $\text{CO}_2$ , diffuse at the same rate at room temperature and pressure?
- A Both are denser than air.
  - B Both compounds contain carbon.
  - C Both molecules contain covalent bonds.
  - D They have the same relative molecular mass,  $M_r$ .

5 Hydrogen chloride is very soluble in water, whereas chlorine is only slightly soluble in water.

Both gases can be dried using concentrated sulfuric acid.

Which diagram represents the correct method of obtaining pure dry chlorine from damp chlorine containing a small amount of hydrogen chloride?



6 Which of the following is **not** a mixture?

- A ethanol
- B petrol
- C steel
- D tap water

7 The table gives the arrangements of electrons in the atoms of four different elements.

Which element does not form an ionic compound with chlorine?

	arrangement of electrons
<b>A</b>	2.1
<b>B</b>	2.4
<b>C</b>	2.8.1
<b>D</b>	2.8.2

8 A compound Y is the only substance formed when two volumes of dry ammonia gas react with one volume of dry carbon dioxide (both volumes measured at s.t.p.).

What is the most likely formula of Y?

- A**  $(\text{NH}_4)_2\text{CO}_3$
- B**  $\text{NH}_2\text{COONH}_4$
- C**  $(\text{NH}_2)_2\text{CO}$
- D**  $\text{NH}_4\text{COONH}_4$

9 For which compound is the type of bonding correct?

	compound	bonding
<b>A</b>	ammonia	ionic
<b>B</b>	carbon dioxide	covalent
<b>C</b>	sodium chloride	covalent
<b>D</b>	water	ionic

10 Why do graphite and diamond have different physical properties?

- A** Diamond has a giant molecular structure but graphite has not.
- B** Diamond occurs naturally but graphite is made artificially.
- C** Graphite is ionic whereas diamond is covalent.
- D** They contain carbon atoms covalently bonded to different numbers of other carbon atoms.

11 Which statement about the particles  $O^{2-}$ ,  $F^-$ ,  $Ne$ ,  $Na^+$  and  $Mg^{2+}$  is true?

They all

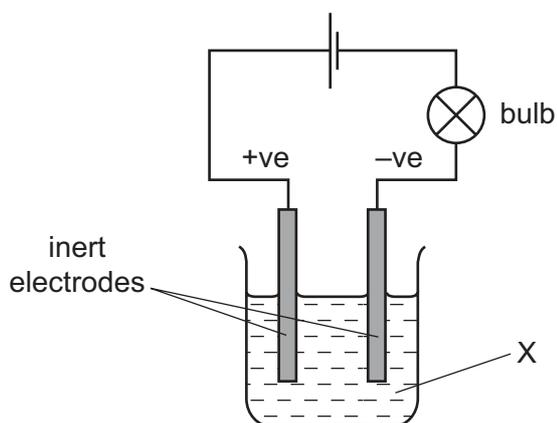
- A contain more electrons than protons.
- B contain more neutrons than protons.
- C contain the same number of electrons.
- D contain the same number of neutrons.

12 The  $M_r$  of oxygen,  $O_2$ , is 32 and the  $M_r$  of sulfur is 256.

What is the formula of a molecule of sulfur?

- A  $S_2$
- B  $S_4$
- C  $S_8$
- D  $S_{16}$

13 In the experiment shown in the diagram, the bulb lights and a gas is produced at each electrode.



What is X?

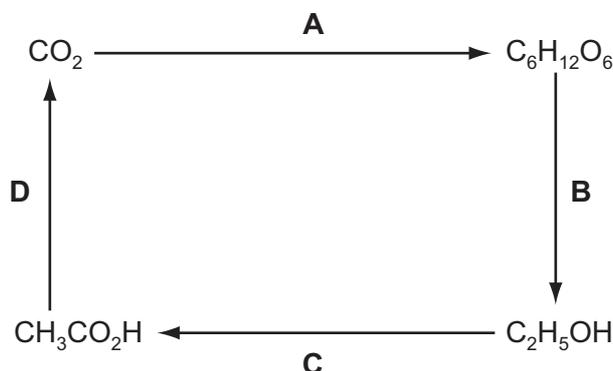
- A aqueous copper(II) sulfate
- B concentrated aqueous sodium chloride
- C ethanol
- D molten lead bromide

14 Which element in the table is an alkali metal?

	melting point $^{\circ}C$	density $g/cm^3$
A	-39	13.60
B	-7	3.10
C	98	0.97
D	1083	8.92

- 15 The diagram shows the steps by which carbon dioxide can be converted into organic products and finally returned to the atmosphere.

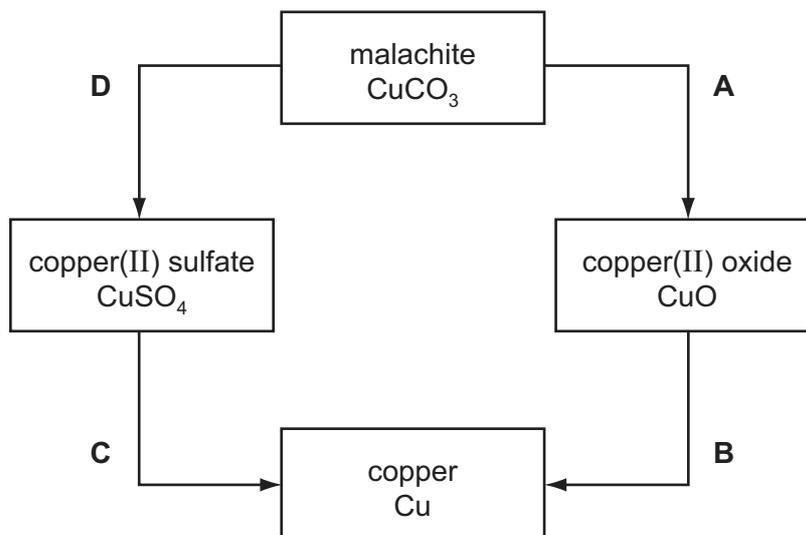
Which step is endothermic?



- 16 Which industrial reaction does **not** involve a catalyst?
- A the cracking of hydrocarbons
  - B the extraction of iron from haematite in a blast furnace
  - C the production of ammonia from nitrogen and hydrogen
  - D the redox reaction involving the removal of combustion pollutants from car exhausts
- 17 Salts containing which of the following anions are always soluble in water?
- A carbonates
  - B chlorides
  - C nitrates
  - D sulfates
- 18 What is a property of the hydroxide,  $\text{OH}^-$ , ion?
- A It combines with hydrogen to form water.
  - B It is present in water.
  - C It readily breaks down into hydrogen ions and oxide ions.
  - D It travels to the cathode in electrolysis of an aqueous solution.
- 19 Which method of preparation of magnesium sulfate is an example of a redox reaction?
- A  $\text{Mg} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2$
  - B  $\text{MgO} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2\text{O}$
  - C  $\text{Mg}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + 2\text{H}_2\text{O}$
  - D  $\text{MgCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2\text{O} + \text{CO}_2$

20 The diagram shows some reactions of copper compounds.

Which change is made by adding an acid?



21 Which process is a renewable energy source?

- A combustion of coal
- B electrolysis of aluminium oxide
- C fractional distillation of petroleum
- D photosynthesis

22 An element X forms an ion  $X^{3-}$ .

In which group of the Periodic Table will this element be found?

- A Group I
- B Group III
- C Group V
- D Group VII

23 Which two gases do not damage limestone buildings?

- A nitrogen and carbon monoxide
- B nitrogen dioxide and carbon monoxide
- C nitrogen dioxide and carbon dioxide
- D sulfur dioxide and carbon dioxide

- 24 A metal, X, has a low melting point, reacts with water, forms only one oxide and is extracted from its ore by electrolysis.

What is the identity of X?

- A aluminium
- B copper
- C iron
- D sodium

- 25 Metallic objects may be decorated by having very thin layers of gold applied to them.

Which properties of gold make it suitable for this use?

	it conducts electricity	it is malleable	it is unreactive
<b>A</b>	x	✓	✓
<b>B</b>	✓	x	✓
<b>C</b>	✓	✓	x
<b>D</b>	✓	✓	✓

- 26 Iron pipes corrode rapidly when exposed to sea water.

Which metal, when attached to the iron, would **not** offer protection against corrosion?

- A aluminium
- B copper
- C magnesium
- D zinc

- 27 Metal **M** will displace copper from aqueous copper(II) sulfate solution, but will not displace iron from aqueous iron(II) sulfate solution. **M** is extracted from its oxide by heating the oxide with carbon.

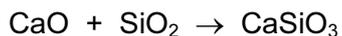
What is the order of reactivity of these four metals?

	least reactive	—————→		most reactive
<b>A</b>	sodium	metal <b>M</b>	iron	copper
<b>B</b>	sodium	iron	metal <b>M</b>	copper
<b>C</b>	copper	iron	metal <b>M</b>	sodium
<b>D</b>	copper	metal <b>M</b>	iron	sodium

28 Which gas **can** be removed from the exhaust gases of a petrol-powered car by its catalytic converter?

- A carbon monoxide
- B carbon dioxide
- C nitrogen
- D steam

29 What is the function of silica,  $\text{SiO}_2$ , in the equation shown below?



- A a basic oxide
- B a reducing agent
- C an acidic oxide
- D an oxidising agent

30 A mixture of two gases has no effect on either damp blue litmus paper or damp red litmus paper.

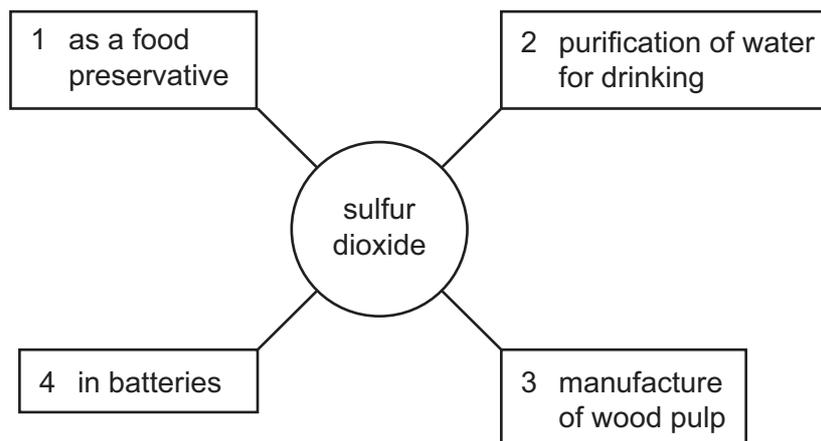
Which gases are present in the mixture?

- A ammonia and oxygen
- B carbon dioxide and sulfur dioxide
- C chlorine and hydrogen
- D hydrogen and oxygen

31 Which contains the greatest mass of nitrogen?

- A 0.5 moles  $(\text{NH}_4)_2\text{SO}_4$
- B 1 mole  $\text{NH}_4\text{NO}_3$
- C 1.5 moles  $(\text{NH}_4)_3\text{PO}_4$
- D 2 moles  $\text{CO}(\text{NH}_2)_2$

32 The diagram shows some of the uses of sulfur dioxide.



Which two of the numbered boxes are correct?

- A** 1 and 2      **B** 1 and 3      **C** 2 and 3      **D** 2 and 4

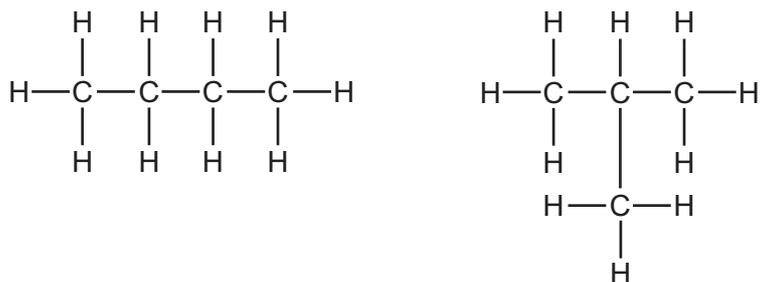
33 Which statement about macromolecules is correct?

- A** Nylon and *Terylene* are both polyesters.  
**B** Proteins and nylon have the same monomer units.  
**C** Proteins have the same amide linkages as nylon.  
**D** *Terylene* and fats are esters but with different linkages.

34 Which row shows both the correct source and the correct effect of the named pollutant?

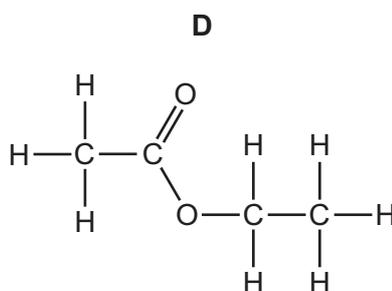
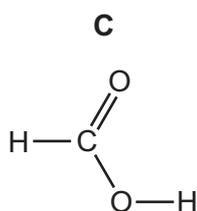
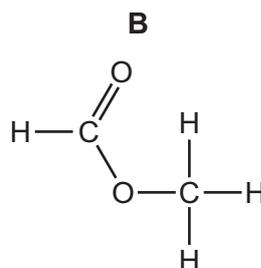
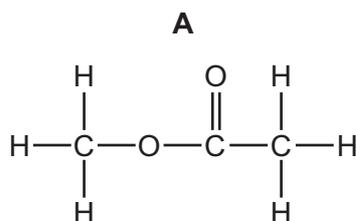
	pollutant	source	effect
<b>A</b>	carbon monoxide	incomplete combustion of carbon-containing materials	global warming
<b>B</b>	oxides of nitrogen	decaying vegetable matter	global warming
<b>C</b>	ozone	photochemical reactions	acid rain
<b>D</b>	sulfur dioxide	volcanoes	acid rain

35 The diagram shows two compounds.



It can be predicted from their formulae that the compounds have the same

- A boiling point.
  - B composition by mass.
  - C melting point.
  - D structural formula.
- 36 Which statement concerning isomers is true?
- A Diamond and graphite are isomers of each other.
  - B Isomers have the general formula  $C_nH_{2n+2}$ .
  - C Isomers have the same molecular formula.
  - D Macromolecules are isomers of the small molecules from which they are made.
- 37 Which compound will react with ethanol to form an ester?



38 In the purification of water, what is the purpose of carbon?

- A to desalinate
- B to disinfect
- C to remove odours
- D to remove solids

39 Four conversions are listed.

- 1 amino acids to proteins
- 2 ethene to poly(ethene)
- 3 proteins to amino acids
- 4 starch to glucose

Which two conversions are **not** examples of hydrolysis?

- A 1 and 2      B 1 and 4      C 2 and 3      D 2 and 4

40 What is the name of the ester  $\text{CH}_3\text{COOC}_2\text{H}_5$ ?

- A ethyl ethanoate
- B ethyl methanoate
- C methyl ethanoate
- D methyl methanoate







**DATA SHEET**  
**The Periodic Table of the Elements**

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Phosphorus	16 <b>S</b> Sulfur	17 <b>Cl</b> Chlorine	18 <b>Ar</b> Argon	5	11 <b>B</b> Boron	12 <b>C</b> Carbon	14 <b>Si</b> Silicon	15 <b>P</b> Phosphorus	16 <b>S</b> Sulfur	17 <b>Cl</b> Chlorine	18 <b>Ar</b> Argon	13	27 <b>Al</b> Aluminium	28 <b>Si</b> Silicon	31 <b>P</b> Phosphorus	32 <b>S</b> Sulfur	33 <b>Cl</b> Chlorine	34 <b>Ar</b> Argon	35 <b>Kr</b> Krypton	13	27 <b>Al</b> Aluminium	28 <b>Si</b> Silicon	31 <b>P</b> Phosphorus	32 <b>S</b> Sulfur	33 <b>Cl</b> Chlorine	34 <b>Ar</b> Argon	35 <b>Kr</b> Krypton	13	70 <b>Ga</b> Gallium	73 <b>Ge</b> Germanium	75 <b>As</b> Arsenic	76 <b>Se</b> Selenium	77 <b>Br</b> Bromine	78 <b>Kr</b> Krypton	79 <b>Kr</b> Krypton	13	70 <b>Ga</b> Gallium	73 <b>Ge</b> Germanium	75 <b>As</b> Arsenic	76 <b>Se</b> Selenium	77 <b>Br</b> Bromine	78 <b>Kr</b> Krypton	79 <b>Kr</b> Krypton	49	115 <b>In</b> Indium	119 <b>Sn</b> Tin	122 <b>Sb</b> Antimony	123 <b>Te</b> Tellurium	124 <b>I</b> Iodine	125 <b>Xe</b> Xenon	126 <b>Xe</b> Xenon	49	115 <b>In</b> Indium	119 <b>Sn</b> Tin	122 <b>Sb</b> Antimony	123 <b>Te</b> Tellurium	124 <b>I</b> Iodine	125 <b>Xe</b> Xenon	126 <b>Xe</b> Xenon	81	204 <b>Tl</b> Thallium	207 <b>Pb</b> Lead	209 <b>Bi</b> Bismuth	210 <b>Po</b> Polonium	211 <b>At</b> Astatine	212 <b>Rn</b> Radon	213 <b>Rn</b> Radon	81	204 <b>Tl</b> Thallium	207 <b>Pb</b> Lead	209 <b>Bi</b> Bismuth	210 <b>Po</b> Polonium	211 <b>At</b> Astatine	212 <b>Rn</b> Radon	213 <b>Rn</b> Radon	80	201 <b>Hg</b> Mercury	204 <b>Tl</b> Thallium	209 <b>Bi</b> Bismuth	210 <b>Po</b> Polonium	211 <b>At</b> Astatine	212 <b>Rn</b> Radon	213 <b>Rn</b> Radon	80	201 <b>Hg</b> Mercury	204 <b>Tl</b> Thallium	209 <b>Bi</b> Bismuth	210 <b>Po</b> Polonium	211 <b>At</b> Astatine	212 <b>Rn</b> Radon	213 <b>Rn</b> Radon	48	112 <b>Cd</b> Cadmium	115 <b>In</b> Indium	122 <b>Sb</b> Antimony	123 <b>Te</b> Tellurium	124 <b>I</b> Iodine	125 <b>Xe</b> Xenon	126 <b>Xe</b> Xenon	48	112 <b>Cd</b> Cadmium	115 <b>In</b> Indium	122 <b>Sb</b> Antimony	123 <b>Te</b> Tellurium	124 <b>I</b> Iodine	125 <b>Xe</b> Xenon	126 <b>Xe</b> Xenon	29	64 <b>Cu</b> Copper	65 <b>Zn</b> Zinc	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	29	64 <b>Cu</b> Copper	65 <b>Zn</b> Zinc	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	28	59 <b>Ni</b> Nickel	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	28	59 <b>Ni</b> Nickel	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	27	59 <b>Co</b> Cobalt	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	27	59 <b>Co</b> Cobalt	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	45	56 <b>Fe</b> Iron	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	45	56 <b>Fe</b> Iron	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	44	101 <b>Ru</b> Ruthenium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	44	101 <b>Ru</b> Ruthenium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	43	55 <b>Mn</b> Manganese	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	43	55 <b>Mn</b> Manganese	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	42	96 <b>Mo</b> Molybdenum	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	42	96 <b>Mo</b> Molybdenum	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	74	52 <b>Cr</b> Chromium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	74	52 <b>Cr</b> Chromium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	73	51 <b>V</b> Vanadium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	73	51 <b>V</b> Vanadium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	72	48 <b>Ti</b> Titanium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	72	48 <b>Ti</b> Titanium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	72	45 <b>Sc</b> Scandium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	72	45 <b>Sc</b> Scandium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	57	89 <b>Y</b> Yttrium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	57	89 <b>Y</b> Yttrium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	57	139 <b>La</b> Lanthanum	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	57	139 <b>La</b> Lanthanum	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	87	226 <b>Ra</b> Radium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	87	226 <b>Ra</b> Radium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	87	227 <b>Ac</b> Actinium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	87	227 <b>Ac</b> Actinium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 5%;"></td> </tr> <tr> <td style="text-align: left;">58</td> <td style="text-align: left;">140 <b>Ce</b> Cerium</td> <td style="text-align: left;">141 <b>Pr</b> Praseodymium</td> <td style="text-align: left;">144 <b>Nd</b> Neodymium</td> <td style="text-align: left;">150 <b>Sm</b> Samarium</td> <td style="text-align: left;">152 <b>Eu</b> Europium</td> <td style="text-align: left;">157 <b>Gd</b> Gadolinium</td> <td style="text-align: left;">162 <b>Dy</b> Dysprosium</td> <td style="text-align: left;">165 <b>Ho</b> Holmium</td> <td style="text-align: left;">167 <b>Er</b> Erbium</td> <td style="text-align: left;">169 <b>Tm</b> Thulium</td> <td style="text-align: left;">173 <b>Yb</b> Ytterbium</td> <td style="text-align: left;">175 <b>Lu</b> Lutetium</td> </tr> <tr> <td style="text-align: left;">58</td> <td style="text-align: left;">140 <b>Ce</b> Cerium</td> <td style="text-align: left;">141 <b>Pr</b> Praseodymium</td> <td style="text-align: left;">144 <b>Nd</b> Neodymium</td> <td style="text-align: left;">150 <b>Sm</b> Samarium</td> <td style="text-align: left;">152 <b>Eu</b> Europium</td> <td style="text-align: left;">157 <b>Gd</b> Gadolinium</td> <td style="text-align: left;">162 <b>Dy</b> Dysprosium</td> <td style="text-align: left;">165 <b>Ho</b> Holmium</td> <td style="text-align: left;">167 <b>Er</b> Erbium</td> <td style="text-align: left;">169 <b>Tm</b> Thulium</td> <td style="text-align: left;">173 <b>Yb</b> Ytterbium</td> <td style="text-align: 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<b>Er</b> Erbium	169 <b>Tm</b> Thulium	173 <b>Yb</b> Ytterbium	175 <b>Lu</b> Lutetium	90	232 <b>Th</b> Thorium	232 <b>Th</b> Thorium	238 <b>U</b> Uranium	90	232 <b>Th</b> Thorium	232 <b>Th</b> Thorium	238 <b>U</b> Uranium	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 5%;"></td> </tr> <tr> <td style="text-align: left;">90</td> <td style="text-align: left;">232 <b>Th</b> Thorium</td> <td style="text-align: left;">232 <b>Th</b> Thorium</td> <td style="text-align: left;">238 <b>U</b> Uranium</td> <td style="text-align: left;">238 <b>U</b> Uranium</td> </tr></table>																										90	232 <b>Th</b> Thorium	232 <b>Th</b> Thorium	238 <b>U</b> Uranium	238 <b>U</b> Uranium																		
5	11 <b>B</b> Boron	12 <b>C</b> Carbon	14 <b>Si</b> Silicon	15 <b>P</b> Phosphorus	16 <b>S</b> Sulfur	17 <b>Cl</b> Chlorine	18 <b>Ar</b> Argon	5	11 <b>B</b> Boron	12 <b>C</b> Carbon	14 <b>Si</b> Silicon	15 <b>P</b> Phosphorus	16 <b>S</b> Sulfur	17 <b>Cl</b> Chlorine	18 <b>Ar</b> Argon																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
13	27 <b>Al</b> Aluminium	28 <b>Si</b> Silicon	31 <b>P</b> Phosphorus	32 <b>S</b> Sulfur	33 <b>Cl</b> Chlorine	34 <b>Ar</b> Argon	35 <b>Kr</b> Krypton	13	27 <b>Al</b> Aluminium	28 <b>Si</b> Silicon	31 <b>P</b> Phosphorus	32 <b>S</b> Sulfur	33 <b>Cl</b> Chlorine	34 <b>Ar</b> Argon	35 <b>Kr</b> Krypton																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
13	70 <b>Ga</b> Gallium	73 <b>Ge</b> Germanium	75 <b>As</b> Arsenic	76 <b>Se</b> Selenium	77 <b>Br</b> Bromine	78 <b>Kr</b> Krypton	79 <b>Kr</b> Krypton	13	70 <b>Ga</b> Gallium	73 <b>Ge</b> Germanium	75 <b>As</b> Arsenic	76 <b>Se</b> Selenium	77 <b>Br</b> Bromine	78 <b>Kr</b> Krypton	79 <b>Kr</b> Krypton																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
49	115 <b>In</b> Indium	119 <b>Sn</b> Tin	122 <b>Sb</b> Antimony	123 <b>Te</b> Tellurium	124 <b>I</b> Iodine	125 <b>Xe</b> Xenon	126 <b>Xe</b> Xenon	49	115 <b>In</b> Indium	119 <b>Sn</b> Tin	122 <b>Sb</b> Antimony	123 <b>Te</b> Tellurium	124 <b>I</b> Iodine	125 <b>Xe</b> Xenon	126 <b>Xe</b> Xenon																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
81	204 <b>Tl</b> Thallium	207 <b>Pb</b> Lead	209 <b>Bi</b> Bismuth	210 <b>Po</b> Polonium	211 <b>At</b> Astatine	212 <b>Rn</b> Radon	213 <b>Rn</b> Radon	81	204 <b>Tl</b> Thallium	207 <b>Pb</b> Lead	209 <b>Bi</b> Bismuth	210 <b>Po</b> Polonium	211 <b>At</b> Astatine	212 <b>Rn</b> Radon	213 <b>Rn</b> Radon																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
80	201 <b>Hg</b> Mercury	204 <b>Tl</b> Thallium	209 <b>Bi</b> Bismuth	210 <b>Po</b> Polonium	211 <b>At</b> Astatine	212 <b>Rn</b> Radon	213 <b>Rn</b> Radon	80	201 <b>Hg</b> Mercury	204 <b>Tl</b> Thallium	209 <b>Bi</b> Bismuth	210 <b>Po</b> Polonium	211 <b>At</b> Astatine	212 <b>Rn</b> Radon	213 <b>Rn</b> Radon																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
48	112 <b>Cd</b> Cadmium	115 <b>In</b> Indium	122 <b>Sb</b> Antimony	123 <b>Te</b> Tellurium	124 <b>I</b> Iodine	125 <b>Xe</b> Xenon	126 <b>Xe</b> Xenon	48	112 <b>Cd</b> Cadmium	115 <b>In</b> Indium	122 <b>Sb</b> Antimony	123 <b>Te</b> Tellurium	124 <b>I</b> Iodine	125 <b>Xe</b> Xenon	126 <b>Xe</b> Xenon																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
29	64 <b>Cu</b> Copper	65 <b>Zn</b> Zinc	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	29	64 <b>Cu</b> Copper	65 <b>Zn</b> Zinc	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
28	59 <b>Ni</b> Nickel	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	28	59 <b>Ni</b> Nickel	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
27	59 <b>Co</b> Cobalt	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	27	59 <b>Co</b> Cobalt	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
45	56 <b>Fe</b> Iron	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	45	56 <b>Fe</b> Iron	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
44	101 <b>Ru</b> Ruthenium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	44	101 <b>Ru</b> Ruthenium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
43	55 <b>Mn</b> Manganese	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	43	55 <b>Mn</b> Manganese	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
42	96 <b>Mo</b> Molybdenum	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	42	96 <b>Mo</b> Molybdenum	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
74	52 <b>Cr</b> Chromium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	74	52 <b>Cr</b> Chromium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
73	51 <b>V</b> Vanadium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	73	51 <b>V</b> Vanadium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
72	48 <b>Ti</b> Titanium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	72	48 <b>Ti</b> Titanium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
72	45 <b>Sc</b> Scandium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	72	45 <b>Sc</b> Scandium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
57	89 <b>Y</b> Yttrium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	57	89 <b>Y</b> Yttrium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
57	139 <b>La</b> Lanthanum	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	57	139 <b>La</b> Lanthanum	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
87	226 <b>Ra</b> Radium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	87	226 <b>Ra</b> Radium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
87	227 <b>Ac</b> Actinium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	87	227 <b>Ac</b> Actinium	64 <b>Cu</b> Copper	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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